$$2l_1\frac{I'}{A_1'} = \frac{2l_1}{A_1'+A_1''+2kl_1}\left(I-\frac{A_1'-A_1''}{2l_1}\,.\,4\pi my\right)+4\pi my,$$

$$2l_1\frac{I''}{A_1''} = \frac{2l_1}{A_1'+A_1''+2kl_1}\left(I-\frac{A_1'-A_1''}{2l_1}\,.\,4\pi my\right)-4\pi ny,$$

whence

$$I'-I'' = \frac{(A_1'-A_1'')I}{A_1'+A_1''+2kl_1}-\left\{\frac{(A_1'-A_1'')^2}{A_1'+A_1''+2kl_1}-(A_1'+A_1'')\right\}\frac{4\pi ny}{2l_1}$$

$$= \frac{(A_1'-A_1'')I}{A_1'+A_1''+2kl_1}+\frac{4A_1'A_1''+2kl_1(A_1'+A_1'')}{A_1'+A_1''+2kl_1}\,.\,\frac{4\pi ny}{2l_1}.$$

For illustration, consider the simplest possible case: let $b_0 = b_1 = \frac{1}{2}A_1$, and $b_2 = b_3 = \ldots = 0$, and let $2kl_1$ be negligible; we have—

$$I'-I'' = I\cos\frac{2\pi t}{T}+A_1\sin^2\frac{2\pi t}{T}\,.\,\frac{4\pi ny}{2l_1},$$

and the equation of current will be—

$$Ry = n\left\{\frac{2\pi}{T}I\sin\frac{2\pi t}{T}-\frac{2\pi nA_1}{l_1}\frac{d}{dt}\left(\sin^2\frac{2\pi t}{T}\cdot y\right)\right\},$$

instead of the simple and familiar linear equation.

III. “Transmission of Sunlight through the Earth's Atmosphere.”

By Captain W. de W. Abney, R.E., F.R.S.

Received February 17, 1887.

(Abstract.)

The observations were made by means of the colour photometer which General Festing and himself introduced last year, and which they described in the Bakerian Lecture for 1886. They extended over more than a year, the object being to ascertain the intensity of the different rays in the solar spectrum after passing through various thicknesses of the atmosphere. Owing to the unpromising results obtained by Langley with his bolometer experiments, it was not anticipated that the variation in the intensities of the different rays would obey any law, but subsequent investigation showed that as a rule the intensity of any ray obeyed the law enunciated by Lord Rayleigh, in that $I' = I\epsilon^{-kx\lambda^{-4}}$, where I and I′ are the initial and transmitted wave-lengths, x the thickness of the medium through which the ray passed, and k a constant, λ being the wave-length. The

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standard illuminating value of the spectrum was taken from observations made in Switzerland at 8000 feet altitude on September 15 at noon. The other observations were made at South Kensington. It was found that with the wind in the proper quarter the sky at the latter place was as pure in colour as in the country, and that measures made on the days on which there was apparently no haze gave results which when combined together gave a minimum value for k of 0·0013. A mean of the results showed that $k = 0·0017$.

The author then discusses the value of the area of the curves so obtained, and shows that astronomers who have used the ordinary logarithmic formula of $I' = Ia^{-\sec ZD}$ have not erred in so doing, but that these results are perfectly concordant with the results obtained by taking the different values of absorption over the whole visible spectrum. He further shows that with the coefficients of transmission for different wave-lengths which Langley has published, the above formula is applicable,which is contrary to the theory which Langley propounded. The author further shows that when using the part of the spectrum to which various photographic salts are sensitive, the areas of the curves of intensities also fall in with the logarithmic formula.

He also points out that if the value of μ in the formula $I' = I\epsilon^{-\mu x}$ (from which the formula $I' = Ia^{\sec ZD}$ is deduced) be divided by 104 in the case of the optical value, or by 255 in the case of the photographic value, when bromoiodide of silver is employed on the sensitised plate, the value of k is obtained. 104 and 255 represent $1/\lambda^4$ of 5570 and 4450 respectively. From this he deduces the fact that the illuminating value of any part of the visible spectrum on any day at any hour can be ascertained by taking the optical and photographic values of total sunlight. This plan not only enables the light which undergoes general absorption to be calculated, but *also* the values of loss of intensity for each ray. He further indicates that a double photographic observation, in one of which the less refrangible end of the spectrum, and in the other of which the more refrangible is used, will give similar results.

Experiments on the photographic methods are described, and the results agree with those which theory indicated would arise.

The author states that the high altitudes in the Alps may not be suitable for observations of wave-lengths in the infra-red; but that they are especially suitable for observations in the visible part of the spectrum, since the atmosphere is very often free from dust, though it may not be free from aqueous vapour, and the latter affects the dark rays vastly more than it does the visible rays. He then points out the probable cause of the presence of particles which scatter light, and briefly discusses the differences which he obtains in his value for the transmission of light, as compared with Bouguer, Seidel, Pritchard, and others. He further shows that observations made by people who are colour-blind in the red tend to diminish the value of the coefficient of transmission, and that the difference between stellar and solar light cannot account for the apparent discrepancy. It would appear that Professor Pritchard's maximum value for the coefficient of transmission at Cairo does not differ much from his.

The values of the different colours in the spectrum which Rood has adopted from Vierordt's method are then discussed, and corrected according to the author's determination of the values on a day in June.

A series of tables close the paper, in which the original observations and the deduced values are given.

Presents, March 10, 1887.

Transactions.

Calcutta:—Asiatic Society of Bengal. Journal (Natural History). Vol. LV. Part 2. No. 3. 8vo. *Calcutta* 1886. Journal (Philological). Vol. LV. Part 1. No. 3. 8vo. *Calcutta* 1886; Proceedings. 1886. Nos. VIII–IX. 8vo. *Calcutta.* The Society.

Dublin:—Royal Irish Academy. Proceedings (Literature, &c.). Vol. II. No. 7. 8vo. *Dublin* 1886. Proceedings (Science). Vol. IV. No. 5. 8vo. *Dublin* 1886; Transactions (Literature, &c.). Vol. XXVII. Parts 6–8. 4to. *Dublin* 1885–86. Transactions (Science). Vol. XXVIII. Parts 21–25. 4to. *Dublin* 1885–86; "Cunningham Memoirs." Nos. II–III. 4to. *Dublin* 1886. The Academy.

London:—Entomological Society. Transactions. 1886. Part V. 8vo. *London.* The Society.

Odontological Society. Transactions. Vol. XVI. 8vo. *London* 1884. *Ditto.* Vol. XVII. No. 1. 8vo. *London* 1884. The Society.

Manchester:—Geological Society. Transactions. Vol. XIX. Parts 3–4. 8vo. *Manchester* 1887. The Society.

Paris:—Société Française de Physique. Collection de Mémoires relatifs à la Physique. Tome III. 8vo. *Paris* 1887. The Society.

Pesth:—Königl. Ungar. Geologische Anstalt. Földtani Közlöny. Kötet XVI. Fuzet 7–12. 8vo. *Budapest* 1886; Mittheilungen aus dem Jahrbuche. Band VIII. Heft. 4. 8vo. *Budapest* 1887; Catalog der Bibliothek. Suppl. 1. 8vo. *Budapest* 1886. The Institution.

Stockholm:—Kongl. Vetenskaps-Akademie. Öfversigt. Årg. 43. No. 10. 8vo. *Stockholm* 1886. The Academy.